Happy Camp Trip Report, June 26th 2014, Black Stain Evaluation Monitoring Plots and "Classic" White Pine Blister Rust Resistance Test Site

By: Phil Cannon and Pete Angwin

Blackstain Evaluation Monitoring Plots

Pete Angwin and the senior author went to Happy Camp on the 26th, and then, in the excellent company of Todd Drake, Rodger Siemers , Katie Schubert and Damon McCartney we went to see several of Douglas-fir plantations that are being surveyed using transects and permanent plots to monitor the intensity and spread rate of black stain root disease. The survey is part of a 2013-2014 Forest Health Monitoring Evaluation Monitoring project that expands and continues plot establishment and evaluation work that started in 1993-1996 with interim measures in 2000-2001. Fourteen of the forty-one study plantations are scheduled to be thinned within the next couple of years. Transects and plots in twenty of the plantations were re-measured and re-monumented in 2013.Transects are being run at three chains of distance between transects and with species and dbh information being collected in a 1/20th acre plots spaced every three chains along these transects. Number 15 wedge prisms are also being used to calculate the basal area from each of these plot centers.

Commented [UFS1]: Are these plots that are spaced 3 chains apart along the transects 1/20th-acre or 1/50th-acre? The FY13 and 14 proposals say they are 1/50th-acre, but since bigger is always better, if they are 1/20th, that is good too!

Figure1. Blackstain sign in Douglas-fir near Happy Camp, California (Photo by Roger Siemers).

In addition, external symptoms of black stain, namely yellowing foliage, foreshortening of needles, a stress cone crop and pitch at the base of the tree are being looked for on each Douglas fir tree in these plots to determine if a tree has been attacked by black stain. External symptoms will also be used to evaluate the size and distribution of black stain root disease infection centers along these transects. Occasionally, a Douglas-fir that shows these symptoms will be hacked into at the base to see if the characteristic black stain sign is also present. Note: on this day we checked on approximately 18 trees suspected of having black stain and found the tell-tale sign of the disease (obvious black streaks in the cambial or recent xylem tissue layers, see Figure 1) in each of these trees. These measurements were previously done in thirty of the plantations in 1993-1996 and 2000-2001, and new transects and plots are being established in eleven plantations that are due to be thinned.

A New Test is Proposed

In general, it was observed that there is a substantial amount of black stain in these plantations and it would appear that the survey approach that will be used will be excellent for determining the actual amount of black stain-caused mortality in each of these plantations.

However, after looking at three of the 11 locations where this study is supposed to be done, we realized that it would also be very useful if this survey could be expanded somewhat to also make an assessment of the impact of thinning on rate of spread of the disease.

A paired plots test with a t-test for statistical analyses is often used to make these kinds of comparisons. However, setting up a t test can be a lot of work. After some consideration and discussion it appeared that this impact of thinning on blackstain study could be piggy backed on the black stain transect study described above by using the information from the transect study to help pick thirty potential paired plots.

To be considered as a pair of plots, two plots from the original transect study must be of the same age and structure at present (approximately the same basal area, quadratic mean diameter, species composition (there are a number of white fir, especially, that are coming in) and, very importantly, they must have approximately the same proportion of trees affected by black stain and this proportion would have to be greater than zero percent).

When thirty pairs of plots have been identified, one of these plots in each pair will be commercially thinned while the other will remain unthinned. To the degree possible, the decision about which plot (of each pair) to thin will be made at random (for example by flipping the "two-bit" piece), however, for logistical reasons, it will be necessary to leave some of the un-thinned plots on those borders of the residual forest that will not be getting a thinning. (Note: only about 15 plots will be needed for the t-test, but it is usual that for one reason or another, not all paired plots work out. This is the rationale for starting with about 30 potential paired plots).

There are three additional important differences between these paired plots and these transect plots. The first is that paired plots will be one-tenth of an acre in size instead of the 1/20th of an acre for the transect plots. This was decided when it was realized that more trees will be needed for evaluation

Commented [UFS2]: Are the "regular" plots 1/20th or 1/50th-acre (see previous comment)? In any case, for the paired plots, a smaller "regular" plot would be nested (concentric) within each 1/10th-acre paired plot, and two sets of data would be collected-one for the trees inside the larger 1/10th-acre paired plot and one for the smaller plot.

purposes in the treated plots (a minimum of 15 leave trees after the thinning would be desirable). This means that the radius for these paired plots should be 37.5 feet. A second difference is that it may also be necessary to move the centers of the paired plots around slightly in order to make sure that both of the plots in any given pair have approximately the same stand composition and basal area prior to the thinning. Offset instructions from the transects will be recorded and GPS'd to show how to find the centers of each of the paired plots. A third difference is that it will be important to leave a buffer of unthinned forest around the control plot in each pair of plots. It is suggested that this would mean extending the radius on the control plot out to one complete chain.

Commented [UFS3]: A couple of points of clarification:
1.The size of the paired plots remains at 1/10th-acre (37.5 feet radius). All that changes is that the outside edge of the unthinned paired control plots needs to at least 30 feet from the edge of the treatment unit boundary (at least 1 chain from plot center to unit boundary).
2.The same "edge effect buffer" rule goes for the paired plots in the treated (thinned) areas. For these, the outside edge of the thinned paired plots needs to at least 30 feet from the edge of the treatment unit boundary (at least 1 chain from plot center to unit boundary).
It sounds like you are doing this anyway!

At the initiation of this study, stand characteristics and number of trees currently dying will be measured for each plot of a pair. These same variables will be measured again on these same plots five, ten and twenty years from now and the differences in the black stain-caused mortality rates between the thinned and the unthinned plots will be analyzed for statistical significance using a paired t-test analysis.

At the end of this day, Todd Drake and Roger Siemers went to the white board and did a masterful job of illustrating and writing down all the steps that need to be taken to set up this t-test and continue the re-measurement and re-monumenting of the transects and plots. It is hoped that those instructions can be appended here and vice versa.

If there are any additional questions, please do not hesitate to ask. This will be a fairly complex t test to set up because there is a fair amount of within stand variation. However, if the plots are set up well, this test will give a clear and efficient answer as to whether commercial thinning accelerates, reduces or has no influence on the rate at which black stain affects a stand of Douglas-fir and this will be a very important piece of information to have when making making many future management decisions in this forest where blackstain is so pervasive.

White Pine Blister Rust at the Classic Resistance Test Site-

Two sites near Happy Camp are being used to test thousands of open-pollinated sugar pine mother trees for resistance to the "Slow Strain" of White Pine Blister rust. The "Outplant" site of this set has been running well, especially since a mister system is now in place to ensure high levels of spores are released from the ribes plants every year. The Classic site, on the other hand, has a few things that need fixing. Our quick visit to this site indicated the following shortcomings:

In the older plantings (planted between 2005 and 2007) which are also all planted on the west side of the crest of the hill, there are only a few ribes bushes that are still alive (maybe 10 out of the 30 that were planted). A couple of leaves on a few of these ribes plants are producing spores and sugar pine that are within one or two trees distance (say 6 feet) of these spore-bearing ribes plants are, in general, very heavily infected with the rust. But these sugar pine are now about ten feet tall and, as such, are 3 to 10 times taller than the ribes plants. For this reason, the urediniospores produced by the rust on these ribes plants have not been able to spread out to the remaining 95% of the sugar pine progeny planted in this trial. There was no foreseeable remedy to this problem. It would probably be wise to just abandon all parts of this test that were planted between 2005 and 2007.

Figure2. A 2007 sugar pine progeny test has completely overgrown the single small ribes plant (in the center of this photo) that was to supposed to provide these trees with heavy and equitable loads of rust inoculum.

On the other hand, the remainder of the test (everything planted since 2009) looked salvageable if some corrective actions are taken soon. Because only about half of the ribes plants that were planted in this section have survived and because only a fraction of the optimal number of ribes plants were planted per set at the time of establishment there are currently nowhere nearly enough ribes plants out there to ensure adequate and equal levels of inoculum reaching all of the sugar pine progeny.

Figure3. Photo showing three blocks in a 2012 planting. So far, the ribes planted in this test (for example the plant with the yellow flag at the center of this photo) are surviving and growing pretty well, but it is doubtful (in the opinion of the senior author) that there are anywhere near enough ribes plants to provide an equitable and sufficient dosage of *Cronartium ribicola* urediniospores spores to challenge all of the sugar pine shown in this test (many of which are marked with white flags). Note: no urediniospores were observed on any of these 2012 ribes plants during a quick sampling during this visit.

What is suggested is to grow approximately 500 ribes plants and then make sure every block is exposed to the inoculum from 20 ribes plants (Note, the current design called for only8 ribes plants per block and only about half of these are actually growing). It might also be very wise to arrange to water and fertilize these ribes plants in their first year to enable them to get established and get up and over the pines in growth so that they can provide a uniform rain of spores over the study site. A fertilizer high in nitrogen would be good, perhaps something like 50 grams per seedling of diammonium phosphate and 100 grams of the same fertilizer for ribes plants that are already established.

It would also probably be wise to consider how much greater levels of sporulation could be induced. Operationally, a mister system might be preferable, but there was some expectation that this kind of infrastructure might get stolen. It must also be remembered that this visit was made during the summer of 2014, one of the driest years on record. Presumably years with wetter springs and summers will produce greater levels of sporulation.

Figure 4. Underside of a ribes leaf with rust uridiniospores being produced. At the time of this visit there were only a few leaves found with this level of inoculum on them and all of these were on ribes plants growing between the oldest blocks of sugar pine (2005, 2009) where ambient air was stagnant, cooler and more humid (refer to Figure1).